Organics Recycling Group
Renewable Energy Association

INFORMATION SHEET

Composting - Noxious weeds

1. Introduction

Compost producers aiming to produce a quality product will want to ensure that weed propagules have been destroyed and any toxins potentially contained in plant species have broken down through good practice composting and verification procedures.

The PAS 100 Specification for composted materials[1] requires that the number of weed seeds and propagules does not exceed zero germinating weed seeds and propagules per litre of compost.

Propagules are seeds and other parts plants necessary for their reproduction.

A **noxious** weed is 'a plant species that has been designated as one that is injurious to agricultural and/or horticultural crops, natural habitats and/or ecosystems, and/or humans or livestock. Typically they are plants that grow aggressively, multiply quickly without natural controls (native herbivores, soil chemistry, etc.), and adversely affect native habitats, croplands, and/or are injurious to humans, native fauna, and livestock through contact or ingestion. Noxious weeds are a large problem in many parts of the world, greatly affecting areas of agriculture, forest management, nature reserves and parks, and other open space lands'[2].

Noxious weeds include:

I. Poisonous weeds

These are weeds that can cause illness, injury, or death to humans or animals. These include plants such as Ragwort (*Senecio jacobae*), Yew (*Taxus baccata*), Hemlock (C*onium maculatum)* and Rhododendron

[1] British Standards Institution's PAS100:2011 Specification for composted material
[2] http://en.wikipedia.org/wiki/Noxious_weed

(*Rhododendron Ponticum*) because they contain toxins which may be poisonous to living organisms.

II. Invasive, non-native weeds

Invasive, non-native weeds are plant species that have been introduced to a place where they do not naturally occur and started to cause problems. They have the ability to spread and transfer from gardens to farmland, upsetting the balance of the ecosystem. They can be characterised as having a very persistent growth form and method of reproduction. At the same time they have fewer natural predators, like pests or diseases, which results in resistance to control. Some examples of invasive, non-native species are: Japanese Knotweed (*Fallopia japonica*), Giant Hogweed (*Heracleum mantegazzianum*), and Himalayan Balsam (*Impatiens glandulifera).*

Composting of noxious weeds

In most cases destruction of weed propagules and breakdown of plant derived toxins occurs in composting heaps that reach and sustain thermophilic temperatures (55 to 75ºC). It is crucial to ensure that adequate air and moisture conditions are maintained during the process. For composting systems that rely on turning/mixing (e.g. open air turned windrows), thorough mixing of each batch is essential to ensure that by the end of the process all material has been exposed to a high temperature for sufficient time.

2. Regulations and guidance

Weeds Act 1959

The 1959 Weeds Act controls and tries to prevent the spreading of five injurious weeds to agricultural land. The supply of compost containing propagules from injurious weeds is likely to be viewed as an offence.

Enforcement of the Weeds Act is carried out by Natural England on behalf of the Department of Environment, Food and Rural Affairs (Defra). It is not an

offence to have these weeds growing on your land; however they must not be allowed to spread to agricultural land, particularly grazing areas or land which is used to produce conserved forage. Enforcement notices can be issued following complaints requiring landowners to take action to prevent the spread of these weeds.

The Act identifies the following five injurious weeds:

- **Common ragwort,**
- **Spear thistle,**
- **Creeping (or field) thistle,**
- **Curled dock, and**
- **Broad-leaved dock.**

To aid their identification Defra's website provides a leaflettitled 'Identification of injurious weeds' which describes each of the above injurious weeds. The leaflet can be downloaded from:

http://www.defra.gov.uk/publications/files/pb4192-injurious-weeds.pdf

For the same purpose, the Scottish Government has published Weed Guidance, which can be found at this link:
http://www.scotland.gov.uk/Resource/Doc/915/0076371.pdf

Ragwort Control Act 2003 and Defra's Code of Practice on how to prevent the spread of ragwort

The Ragwort Control Act amends the Weeds Act 1959. The Act provides for a code of practice to be prepared to give guidance on how to prevent the spread of ragwort. As a result, Defra released its Code of Practice on how to prevent the spread of ragwort, which can be downloaded from www.defra.gov.uk/publications/files/pb9840-cop-ragwort.pdf. The Scottish Government also released guidance on how to prevent the spread of ragwort (see http://www.scotland.gov.uk/Resource/Doc/228241/0061833.pdf).

Further guidance on ragwort identification and the most appropriate means of controlling ragwort can be found in Defra's Guidance on the disposal options

for common ragwort (see http://www.defra.gov.uk/publications/files/pb11050-ragwort-dispose-110315.pdf).

The Wildlife and Countryside Act 1981

This Act made it illegal to "plant or otherwise cause to grow in the wild'' plants listed in Schedule 9, which specifies over 30 plants. They are usually invasive non-native species, which can reproduce vegetatively, i.e., from parts of the plant rather than by seeds. Therefore, incompletely composted parts of vegetation could re-grow in the compost or where the compost is used.

The EC Habitats Directive

The EC Habitats Directive requires European Union Member States to regulate the deliberate introduction of non-native species, so as not to prejudice native fauna and flora. The Conservation (Natural Habitats, &c.) Regulation 1994 transposed the Directive into national low.

Environment Agency's Knotweed Code of Practice

The EA's code has been written for anyone involved in the development and haulage industry who may encounter sites with Japanese Knotweed, or soil containing it. The code can be found at http://www.environment-agency.gov.uk/static/documents/Leisure/Knotweed_CoP.pdf.

Further guidance:

The EA's web site provides detailed information on how to control and dispose of Japanese Knotweed at http://www.environment-agency.gov.uk/homeandleisure/wildlife/130079.aspx.

The Scottish Government's web site contains detailed guidance on control options for invasive, non-native species at http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/Options/Controlofinvasivenon-nati.

N.B.: The Scottish Government prohibits composting as a control option for Japanese Knotweed and Giant Hogweed.

3. Restrictions under the Compost Quality Protocol

The latest version of the Compost Quality Protocol[3] (the CQP) specifies that for inputs to composting, 'The waste must not contain Japanese Knotweed'. Thus, composting processes certified to PAS 100 and the Compost Quality Protocol cannot accept any load containing Japanese Knotweed.

4. Poisonous weeds

These are plant species which may be harmful or poisonous to humans, domesticated grazing animals, and wildlife. They include weeds which produce plant derived toxins like, *grayanotoxin* present in Rhododendron or *coniine* present in Hemlock.

Common Ragwort – *Senecio jacobaea*

Main toxin: pyrrolizidine alkaloids

Ragwort is a native plant that naturally occurs on sand dunes but can be found along roadsides. It is controlled by the Ragwort Control Act 2003 and the guidance available (please see above) aims to prevent the spread of this plant and control its potentially negative impact on animals, especially on horses, which are particularly vulnerable.

The following description of Common Ragwort is to help its identification.

Plant characteristics

- 30 – 90 cm high
- Stem – tough and often tinged red near the base
- Leaves – basal leaves forming a rosette
- Seeds – 70 per flower can remain dormant for over 16 years when buried.
- Flowers - yellow; 200 – 2,000 per plant

[3] The Quality Protocol for the production and use of quality compost from source-segregated biodegradable waste, 2012 edition.

Decomposition of toxin presents in Ragwort (*pyrrolizidine alkaloids, also referred to as 'PA')*

Several research and development projects have been undertaken to establish the degradability of *pyrrolizidine alkaloids*. A first experiment showed a rapid decomposition of the toxin in ragwort stored in waste bags, from 340 mg/kg to less than 40 mg/kg in four weeks and virtually complete loss after 10 weeks[4].

Another study investigated the decomposition of *pyrrolizidine alkaloids* during composting, using a pilot-scale compost heap. The results showed that this toxin was completely degraded during the composting process[5].

Advice for disposal of Ragwort

Small quantities of ragwort can be home composted. It may also acceptable to put ragwort in the council's garden waste collection bin; prior to this using this disposal route, householders (by contacting their council) and local authorities should check whether the contracted composting operators can take ragwort. Some composters may have a policy to reject any load containing Ragwort and/or other poisonous weeds.

According to Defra's 'Guidance on the disposal options for common ragwort' and the Scottish Guidance on ragwort control, 'composting of ragwort should only be carried out where British Standard PAS100 or equivalent can be met'.

Rhododendron – *Rhododendron Ponticum*

Main toxin: grayanotoxin

Rhododendron is one of several poisonous plants commonly found in parks, gardens and the countryside of the UK. Although it is rather an unpalatable

[4] Loss of pyrrolizidine alkaloids on decomposition of ragwort (Senecio jacobaea) as measured by LC-TOF-MS. Crews C, Driffield M, Berthiller F, Krska R.; J Agric Food Chem. 2009 May 13;57(9):3669-73.

[5] Degradation of yew, ragwort and rhododendron toxins during composting. Rupert L Hough, Colin Crews, Duncan White, Malcolm Driffield, Colin D Campbell, Charlotte Maltin.

plant, when eaten by sheep, goats and cattle it may cause vomiting, abdominal pain or sudden death.

Plant characteristics

- Stem/trunk – often dense and twisted
- Flowers – pink – purple
- Leaves – leathery, with dark green upper surface and paler green underside

Rhododendron is controlled under the Wildlife and Countryside Act 1981; therefore, causing the spread of this plant is an offence.

Degradability of *grayanotoxin*

In order to establish the ability of the composting process to degrade the toxin contained in this plant, several research and development projects were carried out. Recent research on degradability of *grayanotoxins* was undertaken by the Scottish Agricultural College. The results showed that this harmful compound present in rhododendron completely degrades during a typical, PAS100 compliant, composting process[6]. According to another project, which tested the decomposition of *grayanotoxins*, 'estimates of exposure to grazing livestock coming into contact with source-segregated green waste compost containing up to 7% of rhododendron in the input to the composting process suggest that GTX III [one of the *grayanotoxins*] poses no appreciable risk.' It is crucial to follow good practice composting, in accordance with the PAS100 standard, to ensure that *grayanotoxins are* fully degraded[5].

[6] Scottish Agricultural Collage, David Michie BSc, The influence of outdoor windrow composting on the concentration of grayanotoxin in rhododendron leaves

Hemlock – *Conium maculatum*

Main toxin: coniine

It usually grows along watercourses and is poisonous to humans and livestock. Especially its long tuberous roots are very toxic; their digestion can cause paralysis, convulsions and death. It produces a distinctive mousy odour when bruised or crushed.

Plant characteristics

- Height – up to 2.5 metres
- Stem – light green, smooth stem with irregular purple-red spots
- Leaves – serrated edges
- Flowers – multiple white, which resemble celery

Yew – *Taxus baccata*

Main toxin: taxine

Yew is a conifer tree, one of the most poisonous plants in Britain. Especially the leaves are very toxic; their ingestion can result in death within minutes. A research study was undertaken to investigate the decomposition of *taxine* during composting. Its results showed that this toxin degraded completely during the composting process[5].

Plant characteristics

Height – 10 to 20 metres (tree)

Bark – thin, scaly brown

Leaves – flat, dark green, arranged in spiral on the stem

Fruits – small red and fleshy

5. Invasive Weeds

The Environment Agency published a leaflet containing guidance on how to manage invasive non-native species. This can be found at http://publications.environment-agency.gov.uk/PDF/GEHO0410BSBR-E-E.pdf.

The leaflet covers the following species:

- Japanese Knotweed,
- Parrot's feather,
- Giant Knotweed,
- Creeping water primrose,
- Himalayan Balsam,
- Hybrid Knotweed,
- Australian swamp stonecrop,
- Giant Hogweed,
- Floating pennywort.

The GB Non-native Species Secretariat

The GB Non-native Species Secretariat was established in order to oversee the implementation of 'The invasive Non-native Species Framework Strategy for Great Britain' and overcome the challenges posed by invasive, non-native species. This organisation's website provides valuable reference material, like species risk assessments and a wide range of photos that aid the identification of these plant species (see www.nonnativespecies.org).

Non-native, invasive species were introduced to Britain in the XIX century, usually as ornament plants and spread rapidly over the years. They have colonised watercourses, forming dense colonies which suppress the growth of native plants. The negative impact of reduced biodiversity can lead to river bank erosion and increase the likelihood of flooding. Control methods aim to kill the plants by chemical means and prevent flowering. Detailed characteristics of the most relevant non-native, invasive plants can be found below.

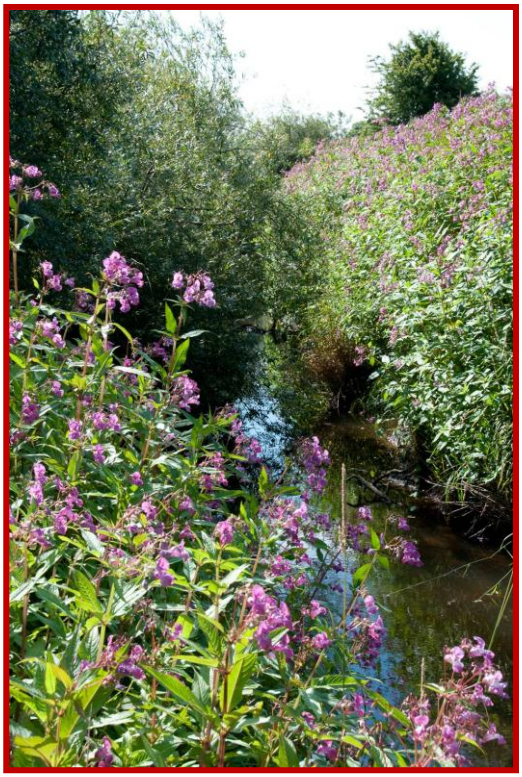
Giant Hogweed – *Heracleum mantegazzianum*

Caution is required to avoid being sprayed with its sap, as may cause blistering and skin irritation.

Plant characteristics

- Height – up to 2 metres
- Leaves and side branches arise from stem joints
- Leaves – shiny dark green, lance-shaped with serrated edges
- Flower - pink-purple, trumpet shape
- Stem – pinkish-red, hollow and fleshy, sappy and brittle
- Seeds – may remain viable for up to two years

Himalayan / Indian Balsam – *Impatiens glandulifera*



Plant characteristics

- Height – up to 5 metres
- Leaves –sharply divided, serrated dark green
- Stem – ribbed, green with red/purple spots and sharp bristles
- Flowers – pink-purple, umbrella shape
- Seeds – 10 mm long by 7 mm wide; up to 50,000 seeds are produced by each plant; may remain viable for up to 15 years

Knotweed

In the UK, Japanese Knotweed was introduced in the mid-nineteenth century as an ornamental plant but over time has become a serious problem. There are three species of invasive knotweed in the UK:

- Japanese Knotweed *Fallopia japonica*;
- Giant Knotweed *Fallopia sachalinensis*;
- Hybrid knotweed Fallo*pia x bohemica* – cross between Japanese and Giant Knotweed.

Japanese Knotweed is the most common and problematic. It spreads vegetatively, through its rhizome (underground stem) and stem fragments can remain dormant in soil for over twenty years before producing a new plant. It has a negative impact on biodiversity, including displacing native plants and can damage buildings and roads because it can grow through concrete and other hard construction materials. It is estimated that the total cost

Plant characteristic - General

- Twig like appearance
- Bamboo like stem (regular nodes)
- Fleshy with hardness like carrot
- Brittle when fresh and break easily like carrot
- Zig-zag pattern

for Japanese Knotweed to the British economy is £165 million per year.[7]

The Environment Agency has published **'the Knotweed code of practice'** (http://www.environment-agency.gov.uk/static/documents/Leisure/Knotweed_CoP.pdf), which gives ecological information on Japanese Knotweed, with comprehensive guidance on identification and explanation of its ability to re-grow in Appendices I – IV. The publication advises on how to prevent spreading, manage the problems and gives examples of management plans in Appendices V and VI., The guidance also includes an explanation of different methods of treatment and disposal options on site and off-site. The **characteristics** given in this document may be useful for identifying Japanese Knotweed[8].

Japanese Knotweed re-growth potential

Sections of rhizome as small as 0.7 grammes or smaller than a one pence piece, can grow into a new plant! Fragmenting the rhizome stimulates the production of small red buds, which grow into new plants.

Plant characteristics

Rhizome

- Young rhizome is white and very soft
- Mature rhizome is dark brown, like coffee granules
- Texture of the outer bark is leathery
- Nodes at 1 - 2 cm
- Nodes slightly enlarged and knotty
- At nodes white fibrous roots are common
- If present fresh-buds at nodes are red/pink

Interior of rhizome

- Longitudinal view:
  - Pale orange and light yellow colour (similar to a carrot)
  - Central core is usually dark orange/brown, like rust, and sometimes hollow
- Cross section: Cortex with rays coming from centre, like spokes from a wheel.

[7] The Economic Cost of Invasive Non-Native Species to the British Economy _ CABI
[8] EA - The Knotweed code of practice, Sept 2006

Composting Japanese Knotweed: R&D

A recent project at the University of Reading evaluated the minimum temperature regime that kills Japanese Knotweed and whether this regime could be achieved by commercial composting processes. The project showed that, under laboratory conditions, pieces of Japanese Knotweed rhizome were inactivated if exposed to temperatures over 45 ˚C for 48 h or 40 ˚C for 72 h or 50 ˚C for 4 h[9]. In practice, many commercial composting operations achieve higher temperatures for longer periods of time. However, as highlighted above, **please note that composting of Japanese Knotweed in a process certified compliant with the Compost Quality Protocol is NOT allowed.**

Advice for disposal of Japanese Knotweed

Due to Japanese Knotweed's re-growth potential it should be incinerated or sent to a landfill site licensed to receive it. Options for on-site / off-site disposal following a Japanese Knotweed 'clearance' are set out below.

When clearing a site of Japanese Knotweed, follow the Environment Agency code of practice. It is necessary to ensure safe legal disposal and obtain an appropriate permit or licence or register an exemption, otherwise disposal of Japanese Knotweed can result in prosecution. A summary of the two options is provided below.

On-site disposal: burning and burial

Controlled burning of the stem, rhizome and crown may be undertaken in accordance with a registered exemption. Any businesses burning Japanese Knotweed waste may need a D7 exemption for burning waste in the open (see http://www.environment-agency.gov.uk/business/topics/permitting/116165.aspx). Businesses who intend to burn Japanese Knotweed waste must inform the EA before any burning takes place.

[9] Can composting kill Japanese Knotweed - Chaofan Xian, Paul Bardos, Steve Robinson (University of Reading and r3 environmental technology ltd)

Soil containing Japanese Knotweed and its burnt remains may be buried on the site of production. Ideally, at least one application of non-persistent herbicide should be used. The excavated soil should be buried to a depth of at least 5 metres and any potentially viable knotweed material covered with a root barrier membrane layer. Site managers should check the periphery of the excavation zone for rhizome. The area of infestation should be recorded, and future owners advised. The EA must be informed at least one week prior to burial or burning activity.

Off-site disposal

Japanese Knotweed should not be removed from site without a waste licence. The material must be taken to a licensed landfill site. Landfill operators must bury it immediately to a depth of 1 - 2 metres (m) and have further buried it to a depth of 5 m within 2 - 4 weeks. Such material must be buried least 7 m from the margin of the landfill cells or any engineering features, and at least 3 m above the base/liner.

Advice for hauliers[10]

Prior to accepting waste material for transfer or disposal, it should be inspected for Japanese Knotweed contamination. If present, the load must be taken to a licensed landfill site. Therefore, hauliers should not haul waste containing this contaminant unless they can ensure its appropriate disposal (see previous section).

Large scale composting

It is important to carry out a Hazard Analysis and Critical Control Point (HACCP) assessment of the feedstock types, composting process and compost end-uses. All composting facilities should have a written operating procedure covering control of identified hazards, and all relevant staff should be trained accordingly.

For example, inspection of the load or identification of noxious weeds could be identified as an important monitoring procedure.

[10] DEFRA – The Code of Practice on how to prevent the spread of Ragwort, July 2004

It is likely to be impractical and not cost effective to thoroughly remove Japanese Knotweed contamination from a load. Therefore, if it is present in a load, the entire load should be rejected and sent for appropriate disposal (see section ‘Option 2 - Off-site disposal).

Should any noxious weeds still remain in the feedstock (not found during inspection), the composting conditions (temperature, moisture and oxygen) and the duration these conditions are maintained is crucial. Some composting systems also include repeated batch mixing in order to achieve thorough, uniform decomposition. Composting conditions should be frequently monitored and recorded.

Never accept topsoil for blending with compost without having first inspected it for rhizome.

Annex 1

Table1 below shows an example of an HACCP assessment carried out in relation to Japanese Knotweed. A similar assessment could also be made for any other invasive plant species that are considered to be relatively resistant to composting.

Table 1 HACCP assessment in terms of Japanese Knotweed

Hazard Analysis and Critical Control Point assessment ~ Japanese Knotweed	
Process step	Reception of green waste after delivery.
Hazard	Japanese Knotweed propagules in green waste survive the composting process and spread in the environment after using the produced compost.
Control measures	Contracts / agreements with green waste suppliers specify that Japanese Knotweed shall be absent in each load delivered for composting. (A control measure but not the Critical Control Point.)
Q1 Do preventive control measures exist? **Q2 Is this step specifically designed to eliminate or reduce the likely occurrence of this hazard to an acceptable level?** **Q3 Could contamination with this hazard occur in excess of**	Yes (ref process step) No (ref process step) Yes (ref process step)

acceptable level(s) or could these increase to unacceptable levels? **Q4 Will a subsequent step eliminate this hazard or reduce its likely occurrence to acceptable levels?** **CCP?**	No (ref process step) **Yes** (ref process step)
Critical limit	Japanese Knotweed absent from each load accepted for composting.
Monitoring procedures	Visual inspection of each load delivered to the site.
Corrective Actions	Reject any load that contains Japanese Knotweed. If accepted load was subsequently found to have contained Japanese Knotweed, dispose according to one of the methods allowed by the regulator. Improve thoroughness of load inspection checks. If Japanese Knotweed is found in a composting/composted batch, dispose of the entire batch according to one of the methods allowed by the regulator.
Record	Contracts and records of communications with 'green waste' suppliers.

	Records of load rejection. Records of any complaints from compost users or those in the compost supply chain.
Verification / comment	No Japanese Knotweed seeds or propagules seen in graded compost, checked before dispatch. Compost analysis shows that germinated weed seeds and growing propagules in every sampled and tested batch is zero (mean number / litre of compost). (In the test specified in PAS 100, weed seedling/propagule species are not determined, which is why the verification is 'zero' weed seedlings/propagules of any species rather than being specific to Japanese Knotweed.)